

## **APPENDIX P**

### **BASELINE AND CAP DETERMINATION FOR THE PAL(S)**

I. Determining the Baseline – MAP shall establish baseline emissions for emission units within any PAL established pursuant to Paragraph 26 using this Appendix separately for each pollutant. MAP shall include the following emissions units within each PAL: all FCCUs, all SRUs (excluding flares, thermal oxidizers), all heaters (>5 mmBTU/hr), and all boilers (>5 mmBTU/hr). The foregoing sentence shall not apply to incinerators except those associated with SRUs. MAP may propose, for EPA approval, to include additional emissions units within a PAL. EPA will consider MAP's proposal based on availability, accuracy and reliability of baseline data, adequacy of monitoring, relative contribution to the Cap, and any other relevant and available information. In addition, MAP may propose for EPA approval alternate methods to calculate baseline emissions and emission rates used to determine compliance with the PAL.

- A. Determining Baseline Concentrations for NO<sub>x</sub>, SO<sub>2</sub>, CO and PM for Calendar years 2000-2002. The baseline concentration shall be in lb/mmBTU separately for each fuel fired for heaters and boilers for all pollutants, in ppmvd @ 0% O<sub>2</sub> for all other emissions units for NO<sub>x</sub>, SO<sub>2</sub>, and CO, in lb/1000 lb coke for PM emissions from FCCUs, in lb/dscf for PM emissions from all other units, and shall be determined as follows:
  - 1. For calendar years 2000-2002, for emissions units that have CEMS installed the baseline concentration shall be established using the average concentration in that time period, or if CEMS were not installed in that time period, at least 3-months of CEMS data from another representative time period, with adjustment for variability of operating parameters during this period as compared to the operating parameters for calendar years 2000-2002, and excluding periods of operation that result in emissions above allowable levels.
  - 2. For calendar year 2002, for emissions units that have CEMS installed by December 31, 2001, the baseline concentration shall be established using the average concentration from January 1, 2002 through December 31, 2002, and excluding periods of operation that result in emissions above allowable levels.
  - 3. For emissions units that do not have CEMS installed the baseline concentration shall be established as follows:
    - a. For heaters and boilers > 40 mmBTU/hr conduct a series of source tests and parametric analysis as provided in Appendix E or provide 30 consecutive days of CEMS data (from temporary CEMS);

- b. For heaters and boilers < 40 mmBTU/hr either conduct a series of source tests and parametric analysis as provided in Appendix E, or conduct tests measuring concentration using a portable analyzer as provided in Appendix F; and
- c. For all other emissions units, submit a proposal for EPA approval for the concentration with supporting information as part of the PAL application required by Paragraph 26.

B. Determining Baseline Utilization for Calendar Years 2000-2002. The baseline utilization for each calendar year for each emissions unit shall be the average utilization of that emissions unit as follows:

1. For FCCUs utilization shall be in terms of an annual average pounds of coke burn per hour with an annual average weight percent hydrogen on coke and annual average CO Boiler auxiliary fuel firing rate in mmBTU/hr for each fuel at annual average combustion O2 by volume percent, combustion temperature in degrees Fahrenheit, and air pre-heat temperature in degrees Fahrenheit;
2. For sulfur recovery units shall be in terms of long tons of sulfur produced per day, at an annual average acid gas feed rate in scfd, NH3 gas feed rate in scfd, air feed rate to reactor furnace (RF) in scfd, annual average acid and NH3 gas concentration in percent by volume, and annual average natural gas feed rate in mol/hr;
3. For heaters and boilers utilization shall be in terms of annual average fuel firing rate for each fuel fired in mmBTU/hr for each fuel at annual average combustion O2 by volume percent, combustion temperature in degrees Fahrenheit, and air pre-heat temperature in degrees Fahrenheit.

C. Determining Baseline Emissions. MAP shall determine baseline emissions for an emissions unit to be included in the PAL as follows:

1. For FCCUs, baseline emissions in tons per year for a particular calendar year shall be calculated as follows:

$$BE_{FCCU} = BC_{FCCU} \times [BRF_{FCCU} + BCOBF_{FCCU}] \times 379 \times MW \times [8760/2000]$$

$$BRF_{FCCU} = [(3.64 \times \text{wt \% } H_B) + (1.53 \times \{100 - \text{wt \% } H_B\})]$$

x [BCBR]

$$\text{BCOBF}_{\text{FCCU}} = [(\text{BUO}_{\text{COB}}) \times (9190) + (\text{BUFG}_{\text{COB}}) \times (\text{BF}_{\text{d-fg}}) + \text{BUNG}_{\text{COB}} \times (8710)]$$

where:

$\text{BC}_{\text{FCCU}}$  = baseline concentration in ppmvd @ 0 % O<sub>2</sub> for that calendar year

MW = molecular weight of the pollutant in pounds per pound-mole

wt % H<sub>B</sub> = annual average weight percent hydrogen on coke for that calendar year as determined by either continuous measurement or daily measurements of CO<sub>2</sub> and moisture in the FCCU flue gas.

BCBR = annual average FCCU regenerator coke burn rate in pounds of coke per hour for that calendar year as determined continuously or on a daily basis by heat balance and flue gas constituents.

$\text{BUO}_{\text{COB}}$  = baseline utilization rate of CO boiler on oil in mmBTU/hr for that calendar year

$\text{BUFG}_{\text{COB}}$  = baseline utilization rate of CO boiler on fuel gas in mmBTU/hr for that calendar year

$\text{BUNG}_{\text{COB}}$  = baseline utilization rate of CO boiler on natural gas in mmBTU/hr for that calendar year

$\text{BF}_{\text{d-fg}}$  = the baseline flow factor on a dry basis for fuel gas and shall be calculated for that calendar year for each application using the equation in section 3.2. of Method 19 in 40 CFR Part 60 Appendix A.

2. For SRUs, baseline emissions in tons per year for a particular calendar year shall be calculated as follows:

$$BE_{SRU} = BC_{SRU} \times [BFRI] \times MW \times [8760/2000]$$

$$BFRI = BWG + [(BNG + BTA)/1-B\%EA] - BSP$$

Where:

$$BFRI = \text{baseline incinerator flue gas flow rate in lb-moles per hour;}$$

$$BC_{SRU} = \text{baseline SRU flue gas baseline concentration in ppmvd at 0 \% O}_2\text{;}$$

$$BWG = \text{baseline waste gas flow in lb-moles per hour;}$$

$$BNG = \text{baseline natural gas flow in lb-moles per hour;}$$

$$BTA = \text{baseline theoretical air in lb-moles per hour;}$$

$$B\%EA = \text{baseline percent excess air; and}$$

$$BSP = \text{baseline sulfur product loss in lb-moles per hour calculated based on an annual average of sulfur recovered in long tons per day for that calendar year.}$$

3. For heaters and boilers, baseline emissions in tons per year for a particular calendar year shall be calculated as follows:

$$BE_{H\&B} \text{ (tpy)} = [(BCO_{H\&B} \times BUO_{H\&B}) + (BCFG_{H\&B} \times BUFG_{H\&B}) + (BCNG_{H\&B} \times BUNG_{H\&B})] \times [8760/2000]$$

Where:

$$BUO_{H\&B} = \text{baseline utilization rate of the heater or boiler on oil in mmBTU/hr;}$$

$$BUFG_{H\&B} = \text{baseline utilization rate of the heater or boiler on fuel gas in mmBTU/hr;}$$

$BUNG_{H\&B}$	=	baseline utilization rate of the heater or boiler on natural gas in mmBTU/hr;
$BCO_{H\&B}$	=	baseline concentration for emissions of a pollutant from the heater or boiler firing oil in lb/mmBTU;
$BCFG_{H\&B}$	=	baseline concentration for emissions of a pollutant from the heater or boiler firing fuel gas in lb/mmBTU;
$BCNG_{H\&B}$	=	baseline concentration for emissions of a pollutant from the heater or boiler firing natural gas in lb/mmBTU.

To determine the contribution of SO<sub>2</sub> emissions from oil firing, the baseline emissions for SO<sub>2</sub> only for all heaters and boilers collectively firing oil shall be calculated by the following alternative method in place of  $BCO_{H\&B} \times BUO_{H\&B}$  in the equation above:

$$BROE = BOFR_{H\&B} \times 42 \times DO \times \text{wt\%S} \times 64/32 \times (1/2000)$$

Where:

$BROE$	=	Baseline refinery-wide SO <sub>2</sub> emissions from oil firing in tons per year;
$BOFR_{H\&B}$	=	Baseline oil firing rate in barrels per year;
$DO$	=	Baseline density of oil in pounds per gallon; and
$\text{wt\%S}$	=	Baseline sulfur content of oil in weight percent sulfur.

4. For other units included within a PAL, MAP shall propose for EPA approval a calculation method consistent with the above methods in its application for the PAL.

II. Establishing the Cap. MAP shall establish the Initial Cap and each annual revision to that Cap used in any PAL submitted for approval by EPA pursuant to this Consent Decree in accordance with procedures of this Appendix.

A. Each initial Cap shall be calculated in accordance with the following equation separately for each pollutant:

$$\text{Initial Cap} = \sum_{a=1}^o (\text{BE}_{\text{FCCU}})_a + \sum_{b=1}^p (\text{BE}_{\text{SRU}})_b + \sum_{c=1}^q (\text{BE}_{\text{H\&B}})_c + X$$

X = for all other units MAP shall propose for EPA approval a calculation method consistent with the above methods in its application for the PAL

Where:

$(\text{BE}_{\text{FCCU}})_a$  = baseline emissions in tons per year for FCCU a within the PAL

o = the number of FCCUs within the PAL;

$(\text{BE}_{\text{SRU}})_b$  = baseline emissions in tons per year for SRU b within the PAL

p = the number of SRUs within the PAL;

$(\text{BE}_{\text{H\&B}})_c$  = baseline emissions in tons per year for heater or boiler c within the PAL; and

q = the number of heaters and boilers within the PAL.

B. Except as provided below, each Cap shall be revised annually as required by Paragraph 26.D. Each annual revision to the Cap shall be in tons per year and calculated in accordance with the equation below separately for SO<sub>2</sub>, NO<sub>x</sub>, and PM. For CO, the Initial Cap shall remain in effect for the full duration of the PAL and shall not be revised to lower it as CO limits become effective.

$$\begin{aligned} \text{Revised Cap} = & \text{Prior Cap} - \left[ \sum_{d=1}^r (\text{BE}_{\text{FCCU}} - \text{PE}_{\text{FCCU}})_d + \sum_{e=1}^s (\text{BE}_{\text{SRU}} - \text{PE}_{\text{SRU}})_e \right. \\ & \left. + \sum_{f=1}^t (\text{BE}_{\text{H\&B}} - \text{PE}_{\text{H\&B}})_f + (\text{BROE} - \text{PROE}) \right] + Y; \end{aligned}$$

$$(PE_{FCCU})_d = [BE_{FCCU}]_d \times [PC_{FCCU}]_d / [BC_{FCCU}]_d;$$

$$(PE_{SRU})_e = [BE_{SRU}]_e \times [PC_{SRU}]_e / [BC_{FSRU}]_e;$$

$$(PE_{H\&B})_f = [PC_{H\&B}]_f \times ([BUO_{H\&B}]_f + [BUFG_{H\&B}]_f + [BUNG_{H\&B}]_f) \times [8760/2000];$$

$$PROE = POFR_{H\&B} \times 42 \times DO \times wt\%S \times 64/32 \times (1/2000)$$

Y = for all other units MAP shall propose for EPA approval a calculation method consistent with the above methods in its application for the PAL;

Where:

Prior Cap = the prior cap for the PAL for the preceding year in tons per year;

r = the number of FCCUs within the PAL for which 365-day rolling average emissions limits were established pursuant to the consent decree in the preceding calendar year;

$(PC_{FCCU})_d$  = the 365-day rolling average emission limit established pursuant to this consent decree in ppmvd at 0% O<sub>2</sub> for FCCU d;

s = the number of SRUs within the PAL for which 365-day rolling average emissions limits were established pursuant to the consent decree in the preceding calendar year;

$(PC_{SRU})_e$  = the 365-day rolling average emission limit established pursuant to this consent decree in ppmvd at 0% O<sub>2</sub> for SRU e;

t = the number of heaters and boilers within the PAL for which 365-day rolling average emissions limits were established pursuant to the consent decree in the preceding calendar year;

$(PC_{H\&B})_f$  = the 365-day rolling average emission limit established pursuant to this consent decree in ppmvd at 0% O<sub>2</sub> for heater or boiler f;

$POFR_{H\&B}$  = Permitted oil firing rate established pursuant to this consent

decree for all heaters and boilers at the refinery in barrels per year;

DO = Maximum or permitted density of oil in pounds per gallon; and

wt%S = Maximum or permitted sulfur content of oil in weight percent sulfur.

If the permitted emission rate (PE) is higher than the baseline emission (BE) rate for particular emission unit, the term BE-PE shall be considered zero for that emissions unit for the purposes of the above summation. For the Revised SO<sub>2</sub> Caps at the Robinson, Texas City, Detroit, Canton and St. Paul Park refineries only, the Revised Cap value produced by the equation above shall be multiplied by 1.15 to arrive at the final value of the Revised Cap, provided, however, that the Revised Cap shall never be more than the Cap for the prior year. For purposes of determining the permitted emission rate for the Catlettsburg FCCU if it is shut down as a compliance option pursuant to Paragraphs 12.D.ii. and 14.D.i., PC<sub>FCCU</sub> for NO<sub>x</sub> shall be deemed equal to 20 ppmvd and PC<sub>FCCU</sub> for SO<sub>2</sub> shall be deemed equal to 25 ppmvd.

### III. Determining Compliance with the Cap.

A. Each day MAP shall calculate the daily emission rate using the following equations for each emissions unit in a PAL:

1. For FCCUs, daily emissions in tons per day for a particular calendar day shall be calculated as follows:

$$DE_{FCCU} = DC_{FCCU} \times [DRF_{FCCU} + DCOBF_{FCCU}] \times 379 \times MW \times [24/2000]$$

$$DRF_{FCCU} = [(3.64 \times \text{wt \% } H_D) + (1.53 \times \{100 - \text{wt \% } H_D\})] \times [DCBR]$$

$$DCOBF_{FCCU} = [(DUO_{COB}) \times (9190) + (DUFG_{COB}) \times (DF_{d-fg}) + DUNG_{COB}) \times (8710)]$$

where:

$DC_{FCCU}$	=	calendar daily average concentration in ppmvd at 0 % O <sub>2</sub> ;
MW	=	molecular weight of the pollutant in pounds per pound-mole;
wt % H <sub>D</sub>	=	calendar daily average weight percent hydrogen on coke as determined by either continuous measurement or daily measurements of CO <sub>2</sub> and moisture in the FCCU flue gas;
DCBR	=	calendar daily average FCCU regenerator coke burn rate in pounds of coke per hour as determined continuously or on a daily basis by heat balance and flue gas constituents;
$DUO_{COB}$	=	calendar daily average utilization rate of CO boiler on oil in mmBTU/hr;
$DUFG_{COB}$	=	calendar daily average utilization rate of CO boiler on fuel gas in mmBTU/hr for that calendar day;
$DUNG_{COB}$	=	calendar daily average utilization rate of CO boiler on natural gas in mmBTU/hr for that calendar day
$DF_{d-fg}$	=	the calendar daily average flow factor on a dry basis for fuel gas and shall be calculated for that calendar day for each application using the equation in section 3.2. of Method 19 in 40 CFR Part 60 Appendix A.

2. For SRUs, calendar daily average emissions in tons per day for a particular calendar day shall be calculated as follows:

$$DE_{SRU} = DC_{SRU} \times [DFRI] \times MW \times [24/2000]$$

$$DFRI = DWG + [(DNG + DTA)/1 - D\%EA] - DSP$$

where:

$$DFRI = \text{calendar daily average incinerator flue gas flow rate in lb-moles per hour;}$$

$DC_{SRU}$	=	calendar daily average SRU flue gas concentration in ppmvd at 0 % O <sub>2</sub> ;
DWG	=	calendar daily average waste gas flow in lb-moles per hour;
DNG	=	calendar daily average natural gas flow in lb-moles per hour;
DTA	=	calendar daily average theoretical air in lb-moles per hour;
D%EA	=	calendar daily average percent excess air; and
DSP	=	calendar daily average sulfur product loss in lb-moles per hour calculated based on an calendar daily average of sulfur recovered in long tons per day for that calendar day.

3. For heaters and boilers, calendar daily average emissions in tons per day for a particular calendar day shall be calculated as follows:

$$DE_{H\&B} \text{ (tpy)} = [(DCO_{H\&B} \times DUO_{H\&B}) + (DCFG_{H\&B} \times DUFG_{H\&B}) + (DCNG_{H\&B} \times DUNG_{H\&B})] \times [24/2000]$$

Where:

$DUO_{H\&B}$	=	calendar daily average utilization rate of the heater or boiler on oil in mmBTU/hr;
$DUFG_{H\&B}$	=	calendar daily average utilization rate of the heater or boiler on fuel gas in mmBTU/hr;
$DUNG_{H\&B}$	=	calendar daily average utilization rate of the heater or boiler on natural gas in mmBTU/hr;
$DCO_{H\&B}$	=	calendar daily average concentration for emissions of a pollutant from the heater or boiler firing oil in

lb/mmBTU;

$DCFG_{H\&B}$  = calendar daily average concentration for emissions of a pollutant from the heater or boiler firing fuel gas in lb/mmBTU;

$DCNG_{H\&B}$  = calendar daily average concentration for emissions of a pollutant from the heater or boiler firing natural gas in lb/mmBTU.

To determine the contribution of SO<sub>2</sub> emissions from oil firing, the daily emissions for SO<sub>2</sub> only for all heaters and boilers collectively firing oil shall be calculated by the following alternative method in place of  $DCO_{H\&B} \times DUO_{H\&B}$  in the equation above:

$DROE = DOFR_{H\&B} \times 42 \times DO \times wt\%S \times 64/32 \times (1/2000)$

Where:

$DROE$  = Daily refinery-wide SO<sub>2</sub> emissions from oil firing in tons per day;

$DOFR_{H\&B}$  = Daily oil firing rate in barrels per day;

$DO$  = Daily density of oil in pounds per gallon; and

$wt\%S$  = Daily sulfur content of oil in weight percent sulfur.

4. For other units included within a PAL, MAP shall propose for EPA approval a calculation method consistent with the above methods in its application for the PAL.

- C. Calculating the total daily emissions for units within the PAL. Each day, MAP shall calculate the total daily emission rate in tons per day as follows:

$$DE_{Cap} = \sum_{g=1}^u (DE_{FCCU})_g + \sum_{h=1}^v (DE_{SRU})_h + \sum_{j=1}^w (DE_{H\&B})_j + DROE + Z$$

Z = for all other units MAP shall propose for EPA approval a calculation method consistent with the above methods in its application for the PAL

Where:

$(DE_{FCCU})_g$  = calendar daily emissions in tons per calendar day for FCCU g within the PAL

u = the number of FCCUs within the PAL;

$(DE_{SRU})_h$  = calendar daily emissions in tons per calendar day for SRU h within the PAL

v = the number of SRUs within the PAL;

$(DE_{H\&B})_j$  = calendar daily emissions in tons per calendar day for heater or boiler j within the PAL; and

w = the number of heaters and boilers within the PAL.

D. Calculating the 365-day rolling average emission rate. Each day, MAP shall calculate the 365-day rolling average emission rate in tons per year as follows:

$$AE_{Cap} = \frac{1}{365} \sum_{k=1}^{365} (DE_{Cap})_k$$

k = the preceding 365 calendar days; and

$(DE_{Cap})_k$  = the daily emission rate in tons per day for calendar day k.